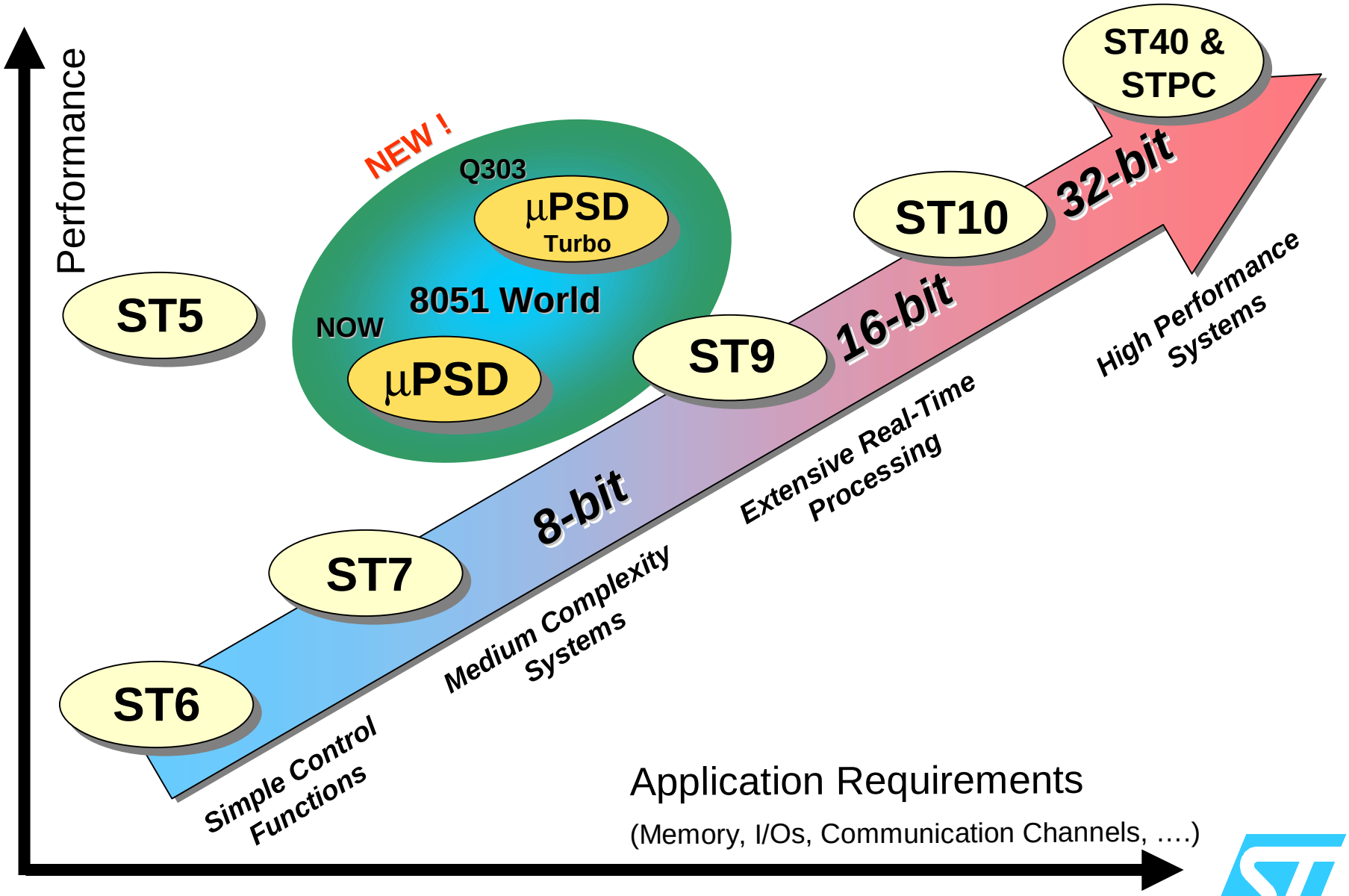
µPSD

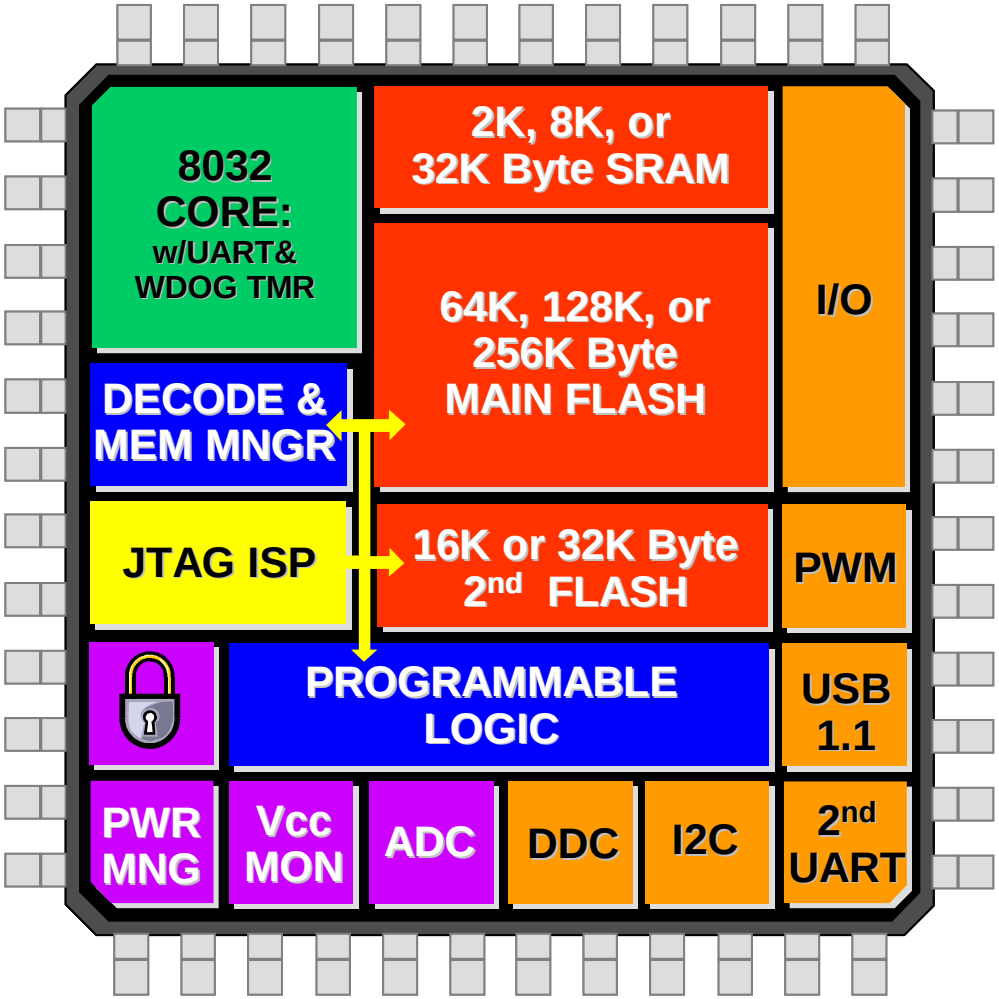
It’s All You Need.

ST's New 8051-based MCU Family



What is µPSD?

- **Standard 8032 MCU Core**
  - (3) 16 bit timers
  - (2) Ext Interrupts
- **Large Dual Bank Flash**
- **Large SRAM**
- **Programmable Logic**
- **USB, Dual UARTs, I2C**
- **PWM, ADC, DDC**
- **Many I/O**
- **Built-in Supervisor**
- **ISP**
  - In-System Programming
- **IAP**
  - In-Application Programming



Just add power and crystal!

What makes µPSD different?

- **PSD Architecture … enhances capability of 8051**
  - PSD = Programmable System Device
  - Dual bank Flash Memory … Superior IAP
  - Memory Management … Seamless paging and memory placement
  - Programmable Logic … Consolidate external logic chips
  - JTAG ISP … perfect for lab and manufacturing

- **Some µPSDs have Big Memory up to 288K bytes… When is larger Flash and SRAM needed?**
  - The use of C language
  - Elaborate user interfaces … menus, graphics, screens
  - Multiple languages and fonts, data tables
  - Faster data transfers
  - Data recording

- **Low Cost**
  - Save $ compared to other 8051 and 8-bit MCU devices with larger SRAM and Flash Memories

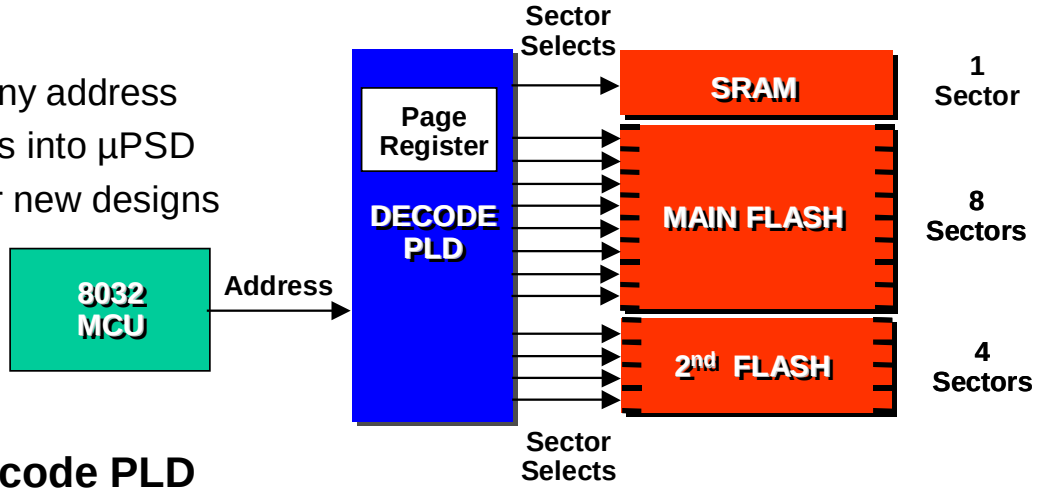
Unique µPSD features

- **Excellent Memory Management**
- **Flexible Memory Allocation**
- **Remote Field Updates**
- **JTAG In System Programming**
- **Programmable Logic**

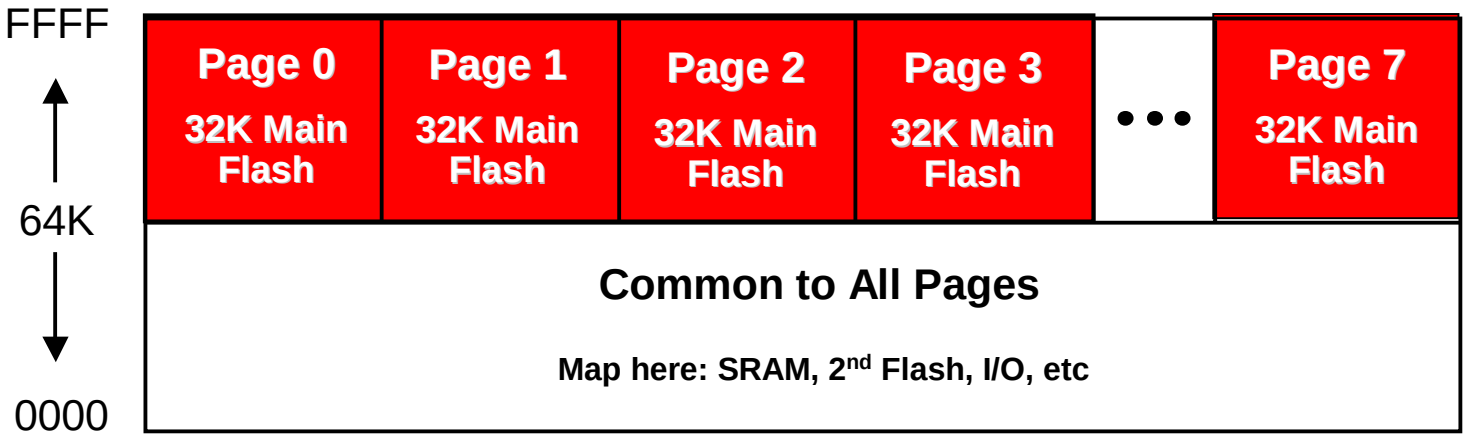
PSD Architecture !!!

Excellent Memory Management

- **Built-in Address Decoding PLD**
  - Map any µPSD memory sector to any address
  - Easily convert existing 8051 designs into µPSD
  - Total memory mapping flexibility for new designs

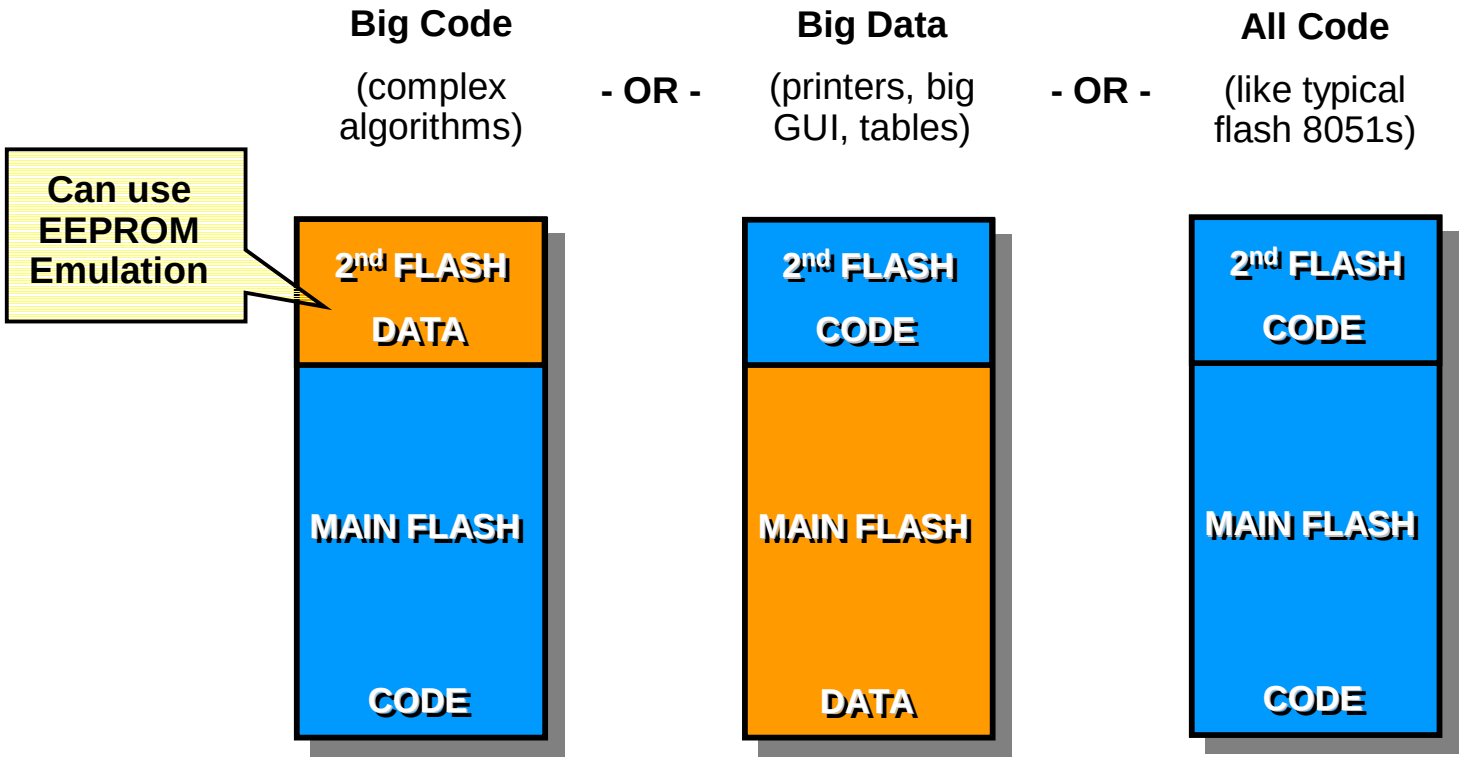


- **Memory Paging is Easy using Decode PLD**
  - Break traditional 8051 64K Byte address limit imposed by only 16 address lines
  - 8-bit page register is built into Decode PLD … it's like having 8 more address lines
  - Paging (or banking) is directly supported by most 8051 C compilers



Flexible Memory Allocation

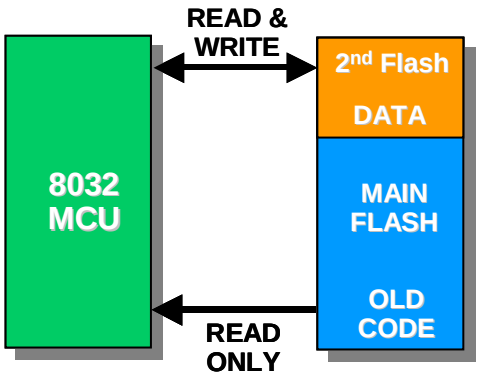
- **8051 Architecture uses a separate address space for code and for data**
- **Allocate dual banks of Flash to meet Application Demands**
  - The Decode PLD controls where Flash memory resides
- **You decide how to split the Flash memory**



Remote Field Updates with IAP

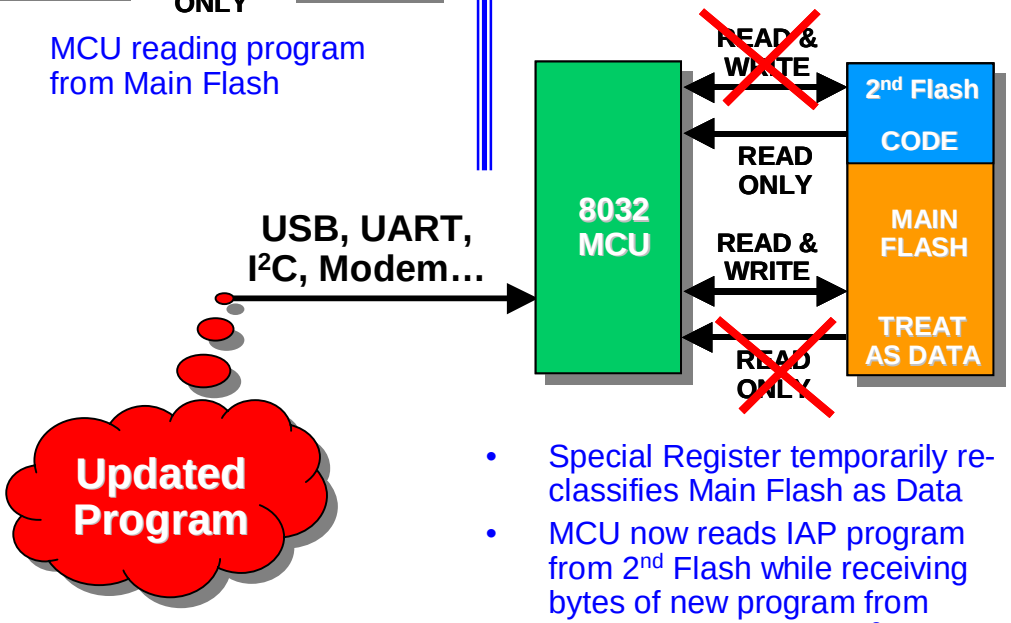
- **8051s typically cannot write to “code” space**
  - Special µPSD register eliminates this limitation
- **Typical Flash memory cannot be read and written at the same time**
  - Dual Banks of Flash eliminate this limitation
  - Read program from one bank while writing to the other bank

1. Before IAP



- MCU reading program from Main Flash

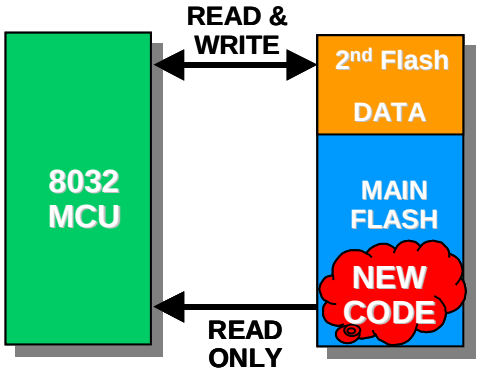
2. During IAP



- Special Register temporarily re-classifies Main Flash as Data
- MCU now reads IAP program from 2nd Flash while receiving bytes of new program from USB, UART, Modem, I²C, etc. and writes the new program to Main Flash

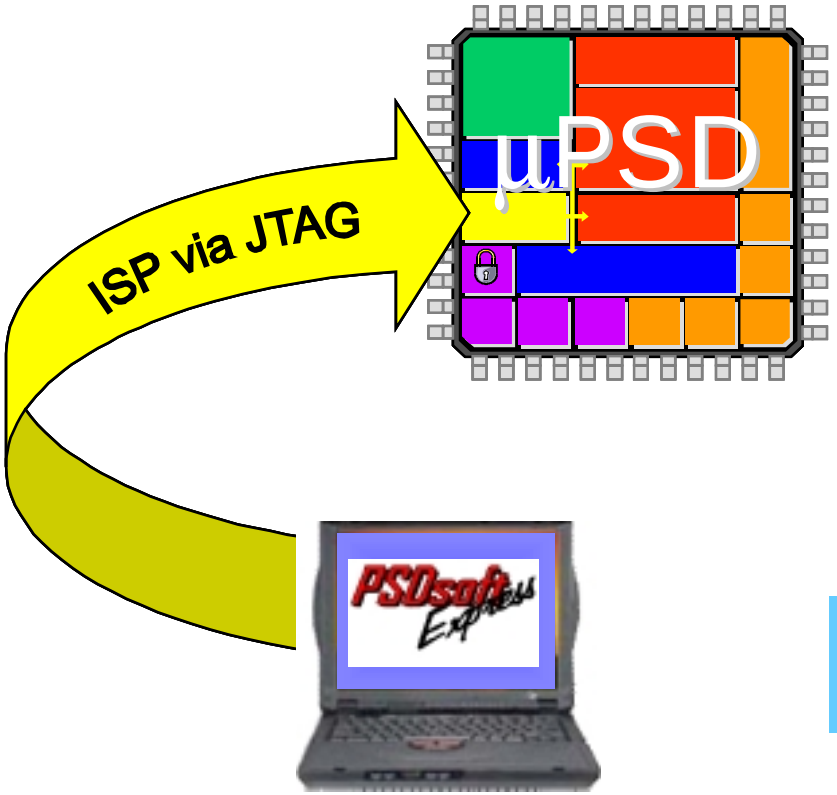
- Special Register classifies Main Flash as Code again
- MCU now reading new program from Main Flash

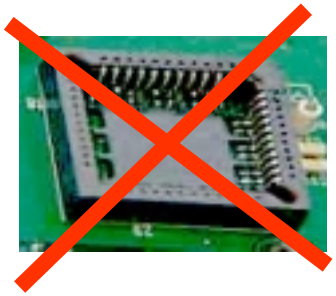
3. After IAP



In-System Programming (ISP)

- **Program blank device, no interaction of 8032 MCU required**
- **Entire chip programs in 10-25 seconds**
- **JTAG serial connection is industry standard**
- **Speedy lab development and manufacturing**





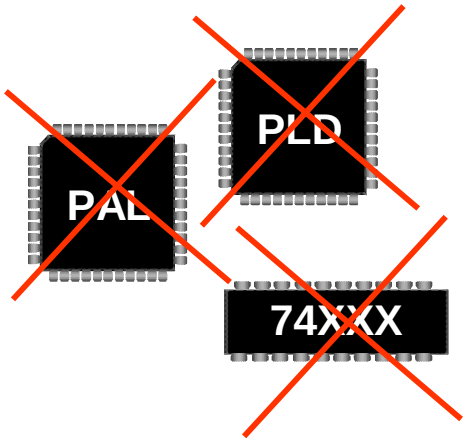
No sockets or pre-programmed parts needed

Engineering Change Order

Last minute changes are OK

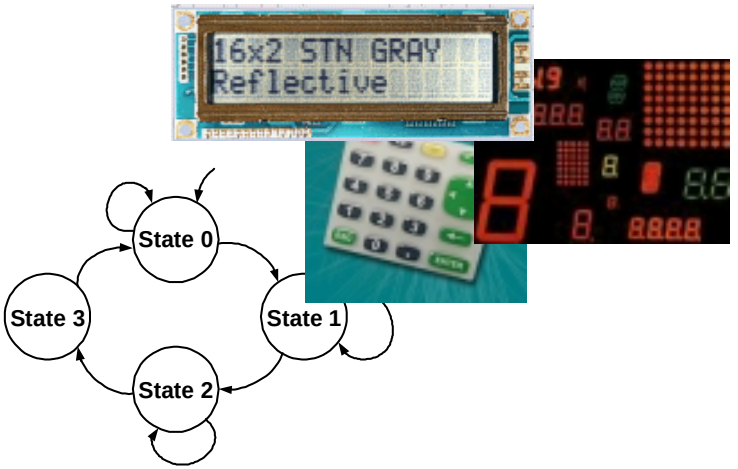
JIT Just-In-Time Inventory Management

Programmable Logic



- **Built-in 16 MacroCell PLD for General Purpose Logic**
- **Similar to standard 22V10 architecture**
- **Eliminate small PLDs, PALs, 74XXX series discrete logic**
- **Easy Point-and-Click PLD configuration with PSDsoft Express**
- **Build:**
  - Glue logic
  - State-machines
  - Shifters
  - Counters
  - Chip-selects for external devices
  - Keypad interfaces
  - Delay generators
  - Clock dividers
  - Decoders
  - Multiplexers

Easy interface to external devices

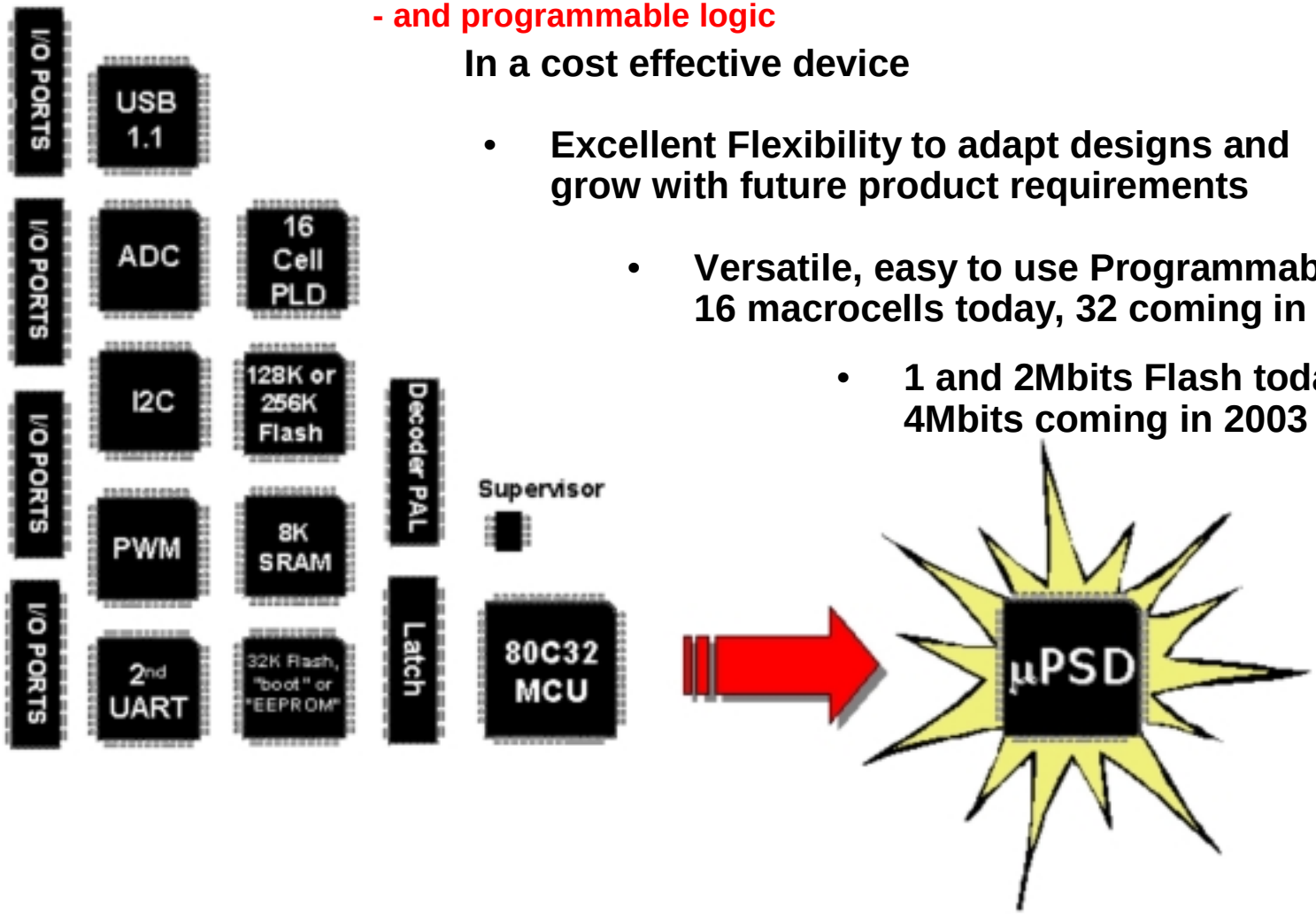


A Unique Combination

- **ST is the only large manufacturer that can bring:**
  - **so much memory**
    - **so many peripherals**
      - **and programmable logic**

In a cost effective device

- **Excellent Flexibility to adapt designs and grow with future product requirements**
  - **Versatile, easy to use Programmable Logic 16 macrocells today, 32 coming in 2003**
    - **1 and 2Mbits Flash today … 4Mbits coming in 2003**



Consolidate Devices

- **What common devices can uPSD eliminate from your circuit board?**

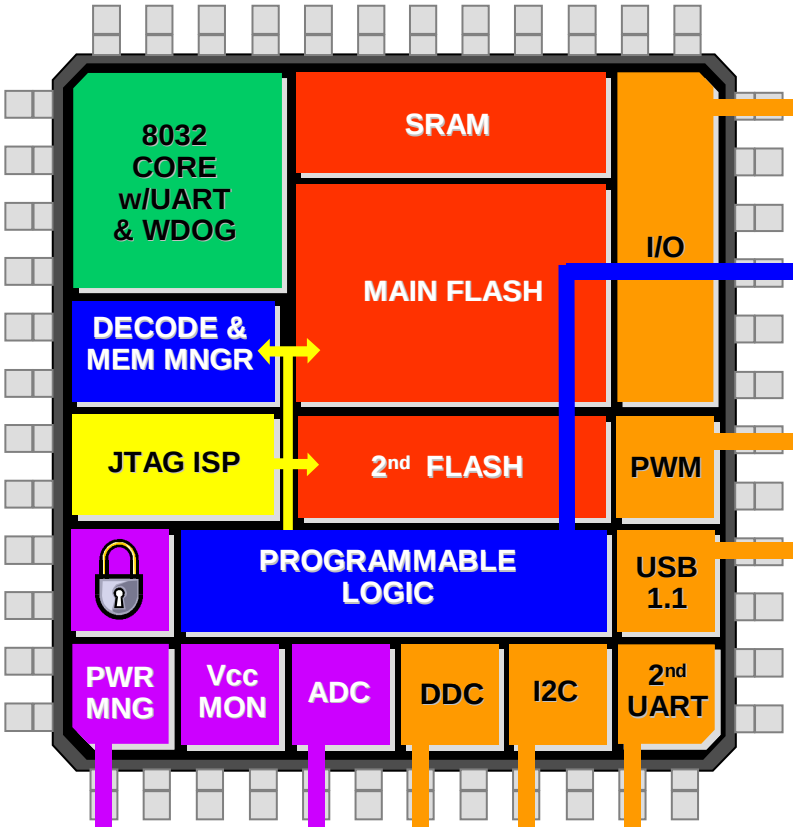
  Sockets – not needed using JTAG ISP

  Glue-logic chips – Use on-chip PLD

  EEPROM chip – Emulate EEPROM using the second Flash memory

  Supervisor chip – Low Vcc Detect and Watchdog included!

Broad Variety of Connections



Keypads, Displays, LEDs, Relays, Contol Panels, Sensors, Acuators

Glue Logic, Clock Dividers, State Machine Sequencers, Simple Counters, Shifters, Chip-Selects

Motor Control, Brightness Control, Position Control, Simple DAC, Tone Generation

Widely used serial connection bus supporting plug-and-play operation.

USB 1.1 Peripheral, 1.5Mbps, Control Endpoint 0 and Intr Endpoints 1 and 2

Connect Modems, Terminals, Displays, GPS Unit, Debug

Connect Displays, Communication Chips, Many Industry Peripherals

Data Display Chan for LCD Projector (DDC1, DDC2B)

Monitor Environment, Data Acquisition, Closed-Loop Control Feedback

Reduce PLD Current for Battery Operation

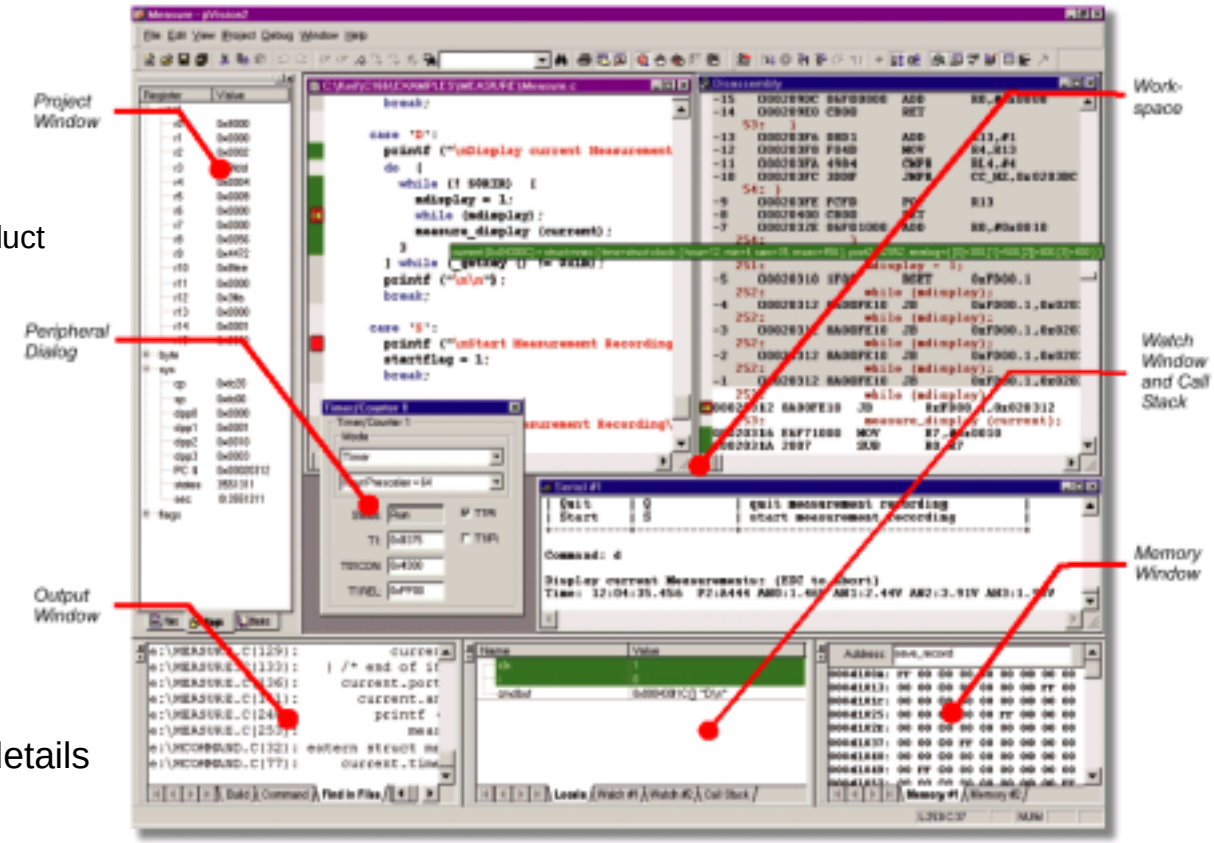
Development Support

$149 USD

- **µPSD C Compiler, Simulator, Debugger, Monitor**
  - Supported by Keil Software, #1 vendor for 8051 architecture
  - Excellent UART ISD51 background debugger for breakpoints, single-step, display memory and registers, etc.
  - Standard 8051 compilers from other vendors are also completely compatible with µPSD.
- **DK3200 development board from ST, US$149**
  - Everything needed: hardware, software, JTAG programmer
  - Firmware drivers, example code, and USB demonstration
  - Windows™ application example programs Flash over USB
  - See Application Note AN1560 for guide
- **In-Circuit Emulator (ICE) from Nohau Inc and Manley**
  - Full speed real-time debugging, deep tracing, memory banking
  - As low as US $250.00 (Manley)
- **PSDsoft Express™ for rapid configuration of µPSD**
  - Point and click design for PLD logic, memory mapping, and pin configuration, free from www.st.com/micropsd

Keil Software Tools

- Integrated Development Environment (IDE)
  - PK51 and DK51
  - Optimized C Compiler
  - Simulator for standard 8032 functions
  - ISD51 Debugger
    - Only takes 700 bytes, no royalties, leave in product
    - Set Breakpoints
    - Single-Step
    - Step though C and Assembly Code
    - Overwrite Variables, Registers, Memory
    - Display Memory
    - Watch Variables
    - Display Registers
  - All in One Environment
  - See www.keil.com/c51 for details

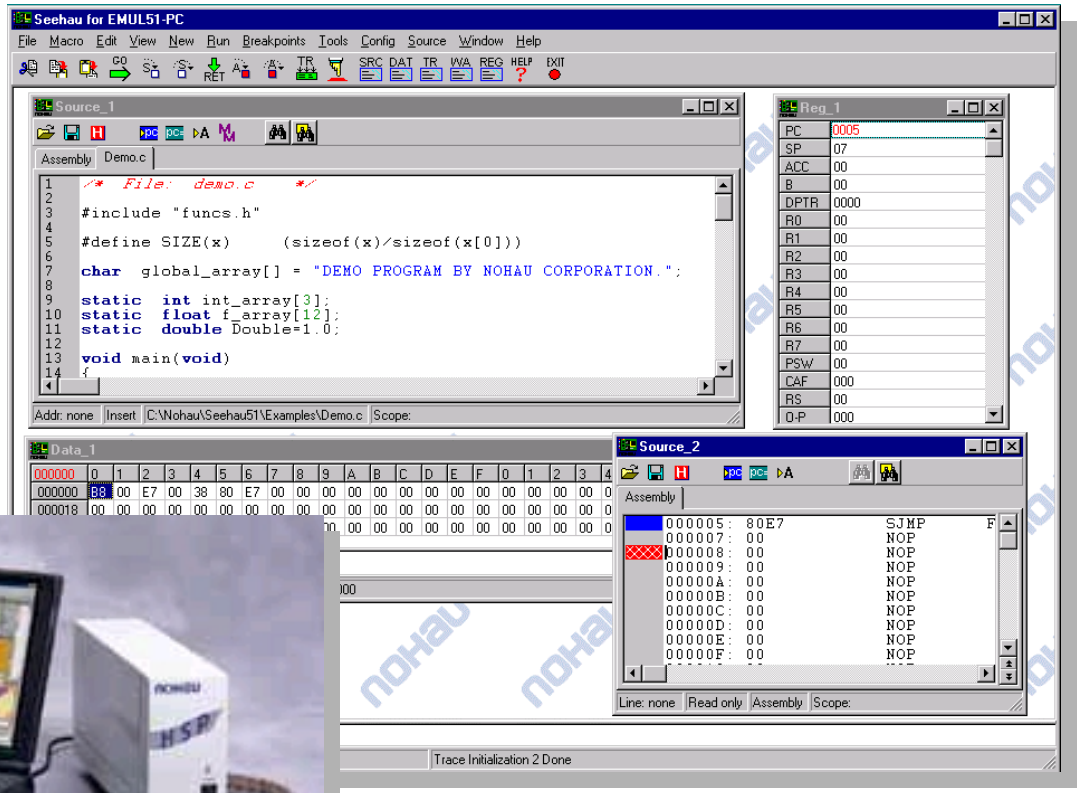


DK3200 Development Kit

- **Includes**
  - DK board, FlashLINK JTAG programming cable, RS-232 serial debugger cable, Power Supply
  - Includes CD with:
    - PSDsoft Express with uPSD project templates and example program
    - Keil 8051 evaluation compiler and ISD51 debugger (limited to 2K bytes code)
    - 8032 firmware for USB, I2C, PWM, ADC, IAP, LCD, UARTs, TIMERS
    - Windows PC USB program to demonstrate USB capabilities including IAP (program flash).
    - Visual C++ source code for Windows USB program is included.
    - App note/Users guide and uPSD data sheets

Nohau In-Circuit Emulator

- In-Circuit Emulator
  - Hardware Emulation, replaces uPSD chip
  - Full Speed Operation, 5V and 3.3V
  - Supports Memory Paging and uPSD architecture
  - Connects directly to DK3000 with no TQFP adapter
  - Hardware Breakpoints
  - 256K Deep Trace
  - Filtered Triggers
  - Timestamps
  - Mixed Source Support
    - C and Assembly
  - Performance Analysis
  - USB, Parallel, or ISA interface to PC

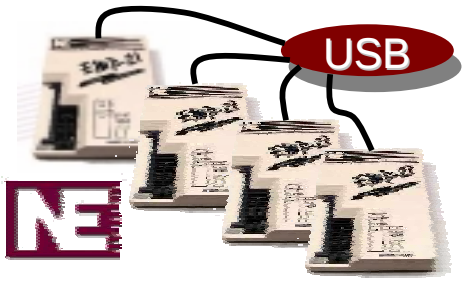


Manley In-Circuit Emulator

- In-Circuit Emulator
  - Hardware Emulation, replaces uPSD chip
  - Full Speed Operation, 5V and 3.3V
  - Supports Memory Paging and uPSD architecture
  - ICE operates from it's own SRAM (up to 288K Bytes) or directly from uPSD Flash Memory.
  - Breakpoints from hardware compare or external signal
  - 128K trace events (optional)
  - PC Parallel support port today, USB in Q303
  - Includes proprietary 8051 A51 assembler and L51 linker.
  - Supports source code debugging for 3rd party C and Assembler
  - Low cost … US$250.00
  - See www.manley.com.cn and www.st.com/micropsd for more details

Programming Support

- **FlashLINK JTAG ISP Programming Cable, ST**
  - Plugs into an PC/Notebook Parallel Port
  - Driven by PSDsoft Express
  - Programs entire part in 10-25 seconds
  - Included in DK3200 Kits, or sold US$59 individually



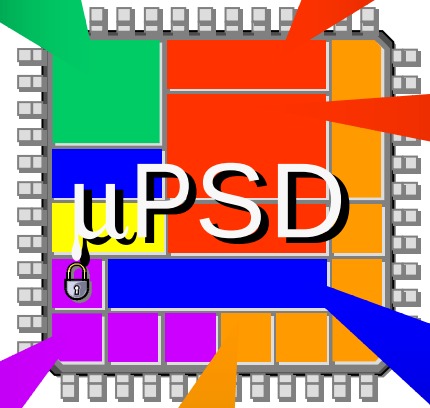
- **Gang JTAG Insertion Programmers, Needham's Electonics**
  - Inexpensive solution for lab or manufacturing
  - Gang many EMP-21 programmers together on USB hub
  - 1 for US$680, 4 for $2200, 8 for $4000, adapters included
  - Low cost EMP-11 for $425 for PC parallel port (no gang)

- **Single-Site Insertion Programmers, BP Micro and HiLo/Tribal**
  - Industry Standard Insertion Programmers
  - Tribal ALL-11P2 is US$1195 + adapter (~$300)
  - All BP Microsystems Engineering programmers support uPSD, contact BP Micro for model and price

HP3070

- **Gang JTAG ISP Programmer, JTAG Technologies**
  - 4-way gang JTAG In-System Programmer for high volume manufacturing
  - Supports many buses: ISA, PCI, VXI, PXI, USB and Agilent (HP) ATE
  - Contact JTAG Technologies for pricing

µPSD Family Growth



CPU

- **Turbo 4-cycle 8032 Core**
  - 10+ MIPs at 40MHz
  - Up from 3 MIPs, 12-cycle core
  - Enhanced timer block with six 16-bit capture/compare, timer/counters, or PWM units
- **JTAG Debug and Emulation**
  - Eliminate external In-Circuit Emulation Hardware

SRAM

- **Up to 32K byte SRAM**
  - Size supports: C/C++, fast math, buffer for large fast communication packets

FLASH

- **Up to 512K byte Main Flash**
  - Size supports: C/C++, RTOS, GUI, data recording, look-up tables, load FPGAs, multi-national products

ANALOG

- **10-bit ADC channels**
  - Greater accuracy

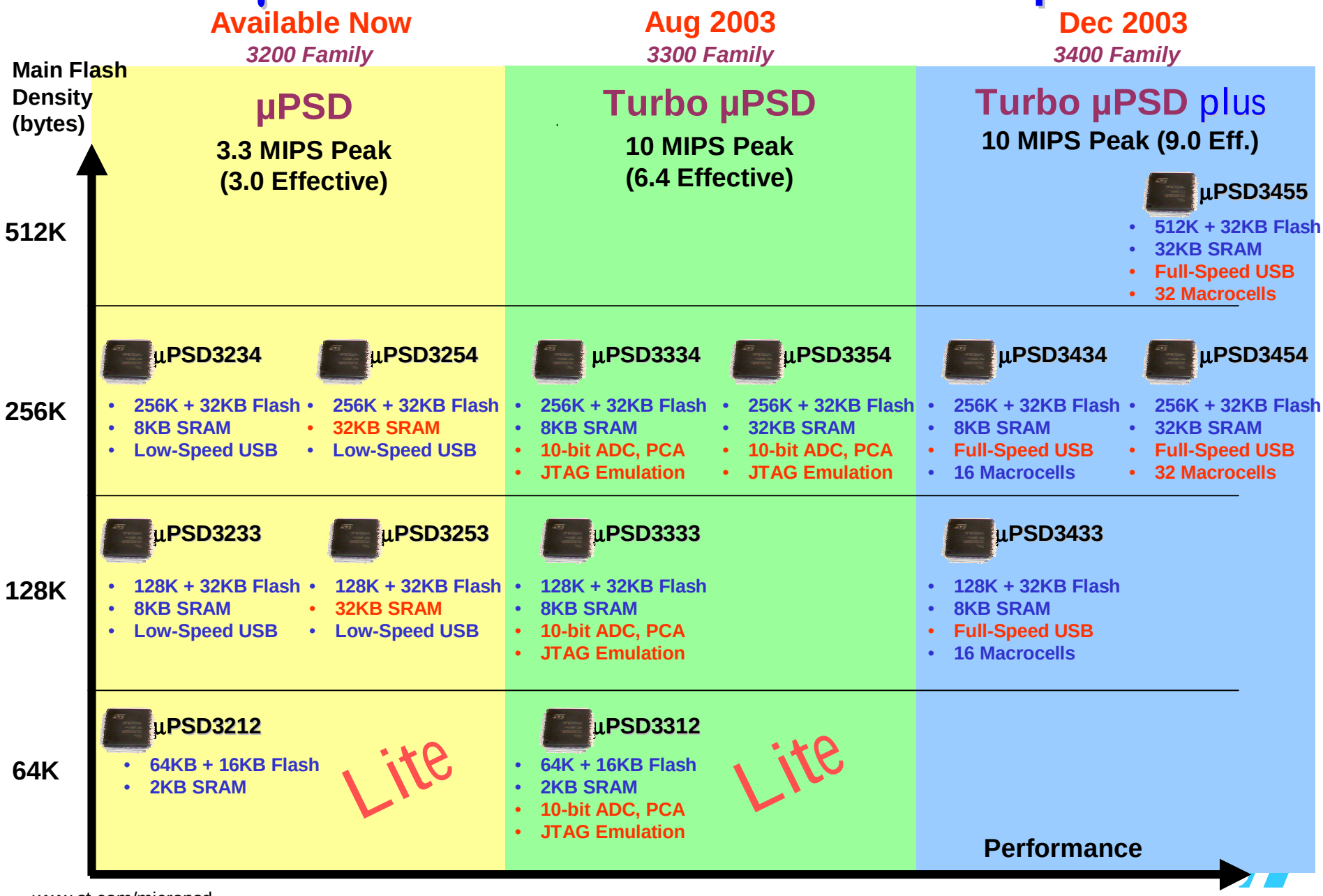
INTERFACE

- **USB 1.1 Full-Speed**
  - 12 Mbits/sec, 5V and 3V
  - FIFOs for rapid transfer of bulk data
- **5V tolerant general I/O**
  - 3V system connects to 5V peripherals

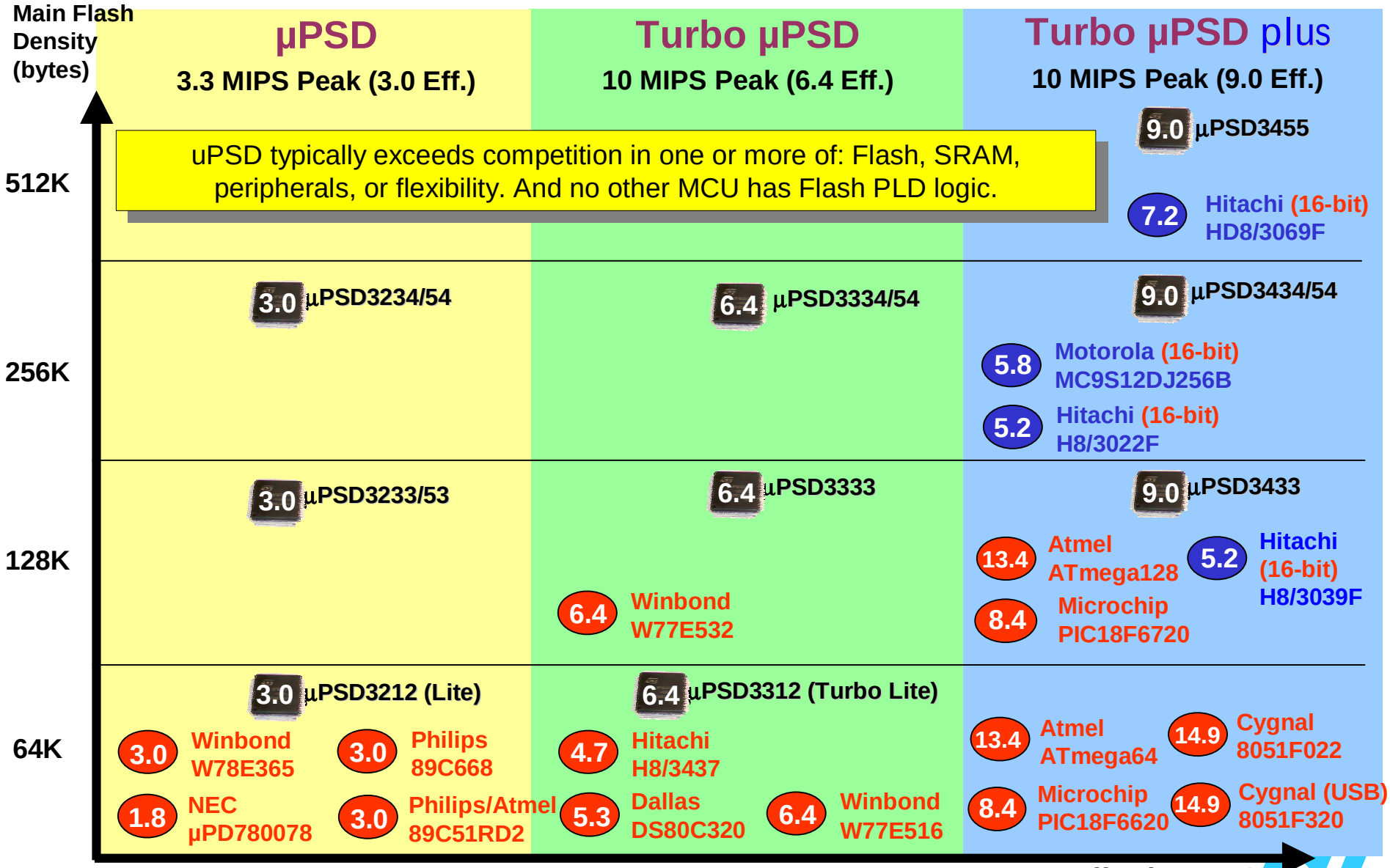
PLD

- **Up to 32 MacroCell PLD**
  - 12 nsec propagation
  - Eliminate external CPLDs
  - Build custom peripherals
  - Build complex glue logic

µPSD Product Roadmap



Competition: Flash Density & Effective MIPS*



*Effective MIPS based on typical mix of instructions using 1, 2, 3, and 4 or more MCU clock cycles at maximum clock frequency.

Current µPSD3200 Series

	µPSD Part Number	Peak Perf @ Clock MHz	Main Flash bytes	2nd Flash bytes	SRAM bytes	PLD Macrocells	USB 1.1 Speed	ADC Channels	Timer/Counters	PWM Channels	UART Channels	I2C Channel	SPI Channel	IrDA Protocol	Wdog/Vcc Reset	JTAG Emulation	Display Data Chn	Max GPIO	8032 Bus Access	Operating Voltage	Temp -40 to +85C	Package
Lite Series	µPSD3212CV-24T6	2 MIP/24	64K	16K	2K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	N	37	N	3.0-3.6	Ind	52-TQFP
	µPSD3212C-40T6	3.3 MIP/40	64K	16K	2K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	N	37	N	4.5-5.5	Ind	52-TQFP
	µPSD3212CV-24U6	2 MIP/24	64K	16K	2K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	N	46	Y	3.0-3.6	Ind	80-TQFP
	µPSD3212C-40U6	3.3 MIP/40	64K	16K	2K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	N	46	Y	4.5-5.5	Ind	80-TQFP
Standard Series	µPSD3233BV-24T6	2 MIP/24	128K	32K	8K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	3.0-3.6	Ind	52-TQFP
	µPSD3233B-40T6	3.3 MIP/40	128K	32K	8K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	4.5-5.5	Ind	52-TQFP
	µPSD3233BV-24U6	2 MIP/24	128K	32K	8K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	3.0-3.6	Ind	80-TQFP
	µPSD3233B-40U6	3.3 MIP/40	128K	32K	8K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	4.5-5.5	Ind	80-TQFP
	µPSD3234BV-24U6	2 MIP/24	256K	32K	8K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	3.0-3.6	Ind	80-TQFP
	µPSD3234A-40T6	3.3 MIP/40	256K	32K	8K	16	Low	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	4.5-5.5	Ind	52-TQFP
	µPSD3234A-40U6	3.3 MIP/40	256K	32K	8K	16	Low	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	4.5-5.5	Ind	80-TQFP
Large SRAM Series	µPSD3253BV-24T6	2 MIP/24	128K	32K	32K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	3.0-3.6	Ind	52-TQFP
	µPSD3253B-40T6	3.3 MIP/40	128K	32K	32K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	4.5-5.5	Ind	52-TQFP
	µPSD3254BV-24U6	2 MIP/24	256K	32K	32K	16	N	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	3.0-3.6	Ind	80-TQFP
	µPSD3254A-40T6	3.3 MIP/40	256K	32K	32K	16	Low	(4)8bit	3	5	2	1	N	N	Y	N	Y	37	N	4.5-5.5	Ind	52-TQFP
	µPSD3254A-40U6	3.3 MIP/40	256K	32K	32K	16	Low	(4)8bit	3	5	2	1	N	N	Y	N	Y	46	Y	4.5-5.5	Ind	80-TQFP

µPSD3300 Turbo Series

Turbo Series Aug 2003

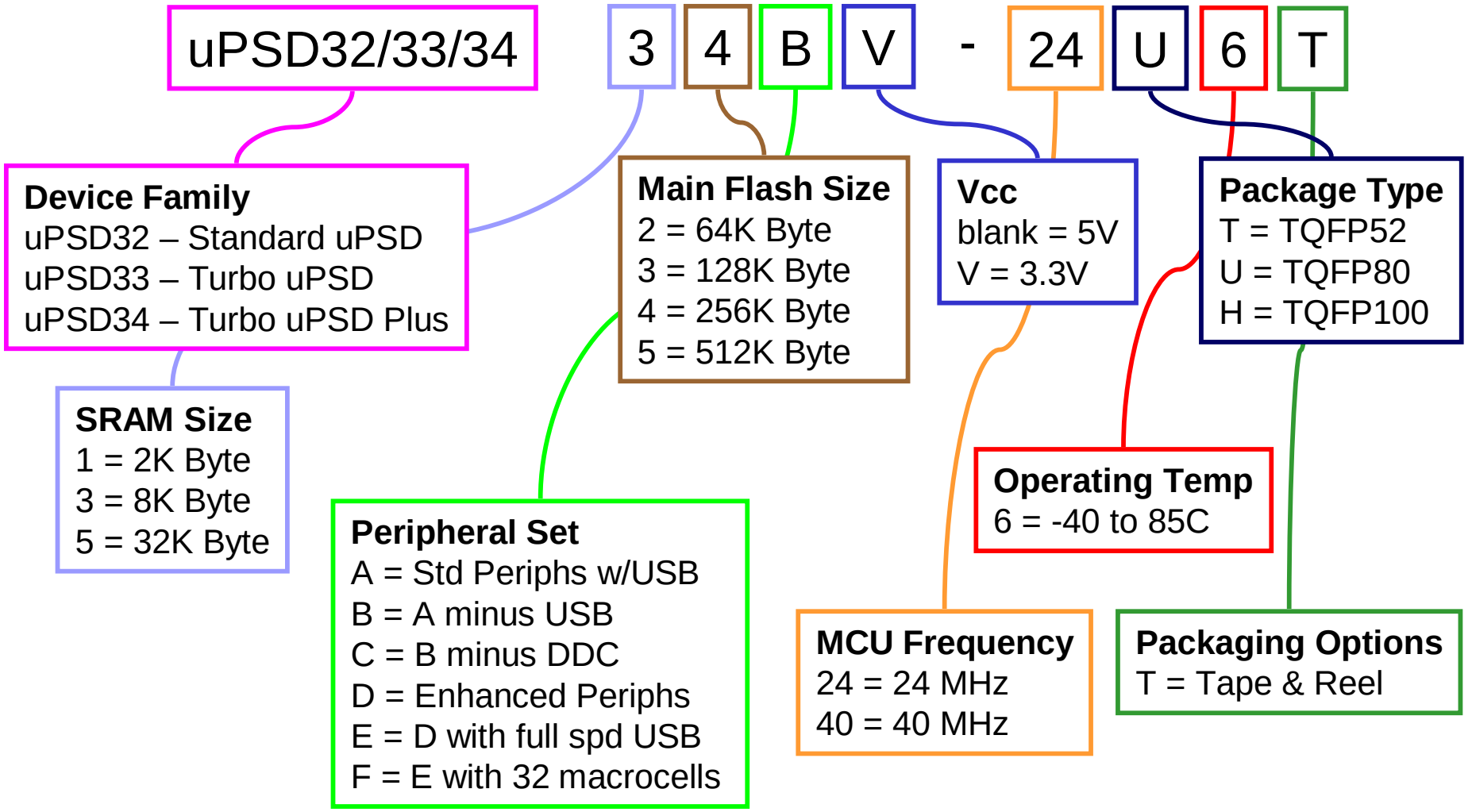
uPSD Part Number	Peak Perf @ Clock MHz	Main Flash bytes	2nd Flash bytes	SRAM bytes	PLD Macrocells	USB 1.1 Speed	ADC Channels	Timer/Counters	PWM Channels	UART Channels	I2C Channel	SPI Channel	IrDA Protocol	Wdog/Vcc Reset	JTAG Emulation	Display Data Chn	Max GPIO	8032 Bus Access	Operating Voltage	Temp -40 to +85C	Package
µPSD3312DV-40T6	8 MIP/40	64K	16K	2K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	3.0-3.6	Ind	52-TQFP
µPSD3312D-40T6	10 MIP/40	64K	16K	2K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	4.5-5.5	Ind	52-TQFP
µPSD3333DV-40T6	8 MIP/40	128K	32K	8K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	3.0-3.6	Ind	52-TQFP
µPSD3333D-40T6	10 MIP/40	128K	32K	8K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	4.5-5.5	Ind	52-TQFP
µPSD3334DV-40U6	8 MIP/40	256K	32K	8K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	45	Y	3.0-3.6	Ind	80-TQFP
µPSD3334D-40U6	10 MIP/40	256K	32K	8K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	4.5-5.5	Ind	80-TQFP
µPSD3354DV-40T6	8 MIP/40	256K	32K	32K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	3.0-3.6	Ind	52-TQFP
µPSD3354D-40T6	8 MIP/40	256K	32K	32K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	36	N	4.5-5.5	Ind	52-TQFP
µPSD3354DV-40U6	8 MIP/40	256K	32K	32K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	45	Y	3.0-3.6	Ind	80-TQFP
µPSD3354D-40U6	8 MIP/40	256K	32K	32K	16	N	(8)10bit	9	6	2	1	1	1	Y	Y	N	45	Y	4.5-5.5	Ind	80-TQFP

µPSD3400 Turboplus Series

Turbo plus Series Dec 2003

µPSD Part Number	Peak Perf @ Clock MHz	Main Flash bytes	2nd Flash bytes	SRAM bytes	PLD Macrocells	USB 1.1 Speed	ADC Channels	Timer/Counters	PWM Channels	UART Channels	I2C Channel	SPI Channel	IrDA Protocol	Wdog/Vcc Reset	JTAG Emulation	Display Data Chn	Max GPIO	8032 Bus Access	Operating Voltage (* = 5V Tolerant I/O)	Temp -40 to +85C	Package
µPSD3433EV-40U6	10 MIP/40	128K	32K	8K	16	Full	(8)10bit	9	6	2	1	1	1	Y	Y	N	62	N	3.0-3.6*	Ind	80-TQFP
µPSD3434EV-40U6	10 MIP/40	256K	32K	8K	16	Full	(8)10bit	9	6	2	1	1	1	Y	Y	N	62	N	3.0-3.6*	Ind	80-TQFP
µPSD3434FV-40H6	10 MIP/40	256K	32K	8K	32	Full	(8)10bit	9	6	2	1	1	1	Y	Y	N	62	Y	3.0-3.6*	Ind	100-TQFP
µPSD3454FV-40U6	10 MIP/40	256K	32K	32K	32	Full	(8)10bit	9	6	2	1	1	1	Y	Y	N	62	N	3.0-3.6*	Ind	80-TQFP
µPSD3455FV-40H6	10 MIP/40	512K	32K	32K	32	Full	(8)10bit	9	6	2	1	1	1	Y	Y	N	62	Y	3.0-3.6*	Ind	100-TQFP

µPSD Part Numbering Scheme



µPSD Web Site

- **Visit µPSD web site for the latest info and software**

- **www.st.com/micropsd**
  - Data Sheets
  - Application Note
  - Development Software
  - Firmware Updates
  - Application Block Diagrams
  - Product Presentation
  - 3rd Party Tools

PSDsoft Express

Ordering Information for Tools

µPSD3200 Development Tools Ordering Information

Tool	Vendor	Part Number	Comment	Retail Price (US$)	Contact
Development Kit	ST	DK3200-110 (110VAC power supply) 0K3200-220 (220VAC power supply)	Includes board, cables, FlashLINK JTAG programmer, PSDsoft Express, Keil demo compiler w/ISD51 debugger, uPSD firmware drivers, USB Windows demo	$149 Order from local ST sales distribution office.	www.st.com/micropsd
Configuration Software	ST	PSDsoft Express	For configuring uPSD programable logic, memory map, I/O. Also drives FlashLINK.	Download for Free	www.st.com/micropsd
8051 C Compiler/Software Debugger	Keil Software Inc (See Note Below *)	PK51 or DK51	Either includes ISD51 UART debugger. PK51 has RTOS and extended support for memory banking (paging).	$2,595 for PK51/$2,095 for DK51 or Free upgrade supports uPSD if already own a licenced copy	www.keil.com
In-Circuit Emulator for real-time debugging.	Nohau Corp.	EMUL51-PC for uPSD3200	Many options depending on features	$995 - $6900	www.nohau.com
FlashLINK JTAG Programmer for lab and medium volume mfg. ISP programming with chip soldered to circuit board.	ST	FL-101	Connects to PC parallel port. Included in DK3200 kits.	$59 Order from local ST sales distribution office.	www.st.com/micropsd
JTAG Gang Programmer for very high volume mfg. ISP programming with chip soldered to circuit board.	JTAG Technlogies Inc.	PSDPROG	PC card performs ISP on 4 products containing a uPSD simultaneously. Also works in HP3070 ATE equipment.	Contact JTAG Technologies Inc.	www.jtag.com
Low-cost gang Insertion Programmer for med-hi volume mfg. For pre-programming individual chips before soldering.	Needhams Electronics	EMP-21 or EMP-11 Socket: E1121-TQ80A (80 pin) Socket: E1121-TQ52A (52 pin)	Gang many EMP-21 units on USB Hub for simultaneous programming. EMP-11 is single site only for PC parallel port	EMP-11 is $425 (qty 1) EMP-21 for $680 (qty 4) EMP-21 for $2200 (qty 8) EMP-21 for $4000 Prices include one adaptor for each unit.	www.needhams.com
Single-Site Insertion Programmer. For pre-programming individual chips before soldering.	Tribal/HiLo	ALL-11P2 80-pin Adapter: 80-PIN-QFP 52-pin Adapter: 52-PIN-QFP	Common Insersion programmer. 8-way gang programmer coming in future.	ALL-11P2 is $1195 80-PIN-QFP is $300 52-PIN-QFP is $260	www.tribalmicro.com
Single-Site Insertion Programmer. For pre-programming individual chips before soldering.	BP Micro	All BP Micro Engineering programmers will program uPSD. 80-pin socket modules: Automated …. FASM80QD Manual … FSM80QD 52-pin socket adaptors: Automated … FASM52QBM Manual FSM52QBM	Common Insersion programmer	Contact BP Micro for pricing.	www.bpmicro.com

* 8051 C language compilers or 8051 assembly compilers from any tool vender will work as long the tool complies to standard 8051 architecture. However, tools from Keil support the uPSD3200 family directly, and all example uPSD firmware supplied by ST will compile directly with Keil tools with no modifications required.

Summary

µPSD Features	µPSD Benefits
Large Integrated SRAM and Flash Memories	Single Secure Device Fulfills Memory Requirements
Programmable Memory Management	Flexibility for New Designs, Easily Convert 8051 Designs
Dual Bank Flash Memories	Robust and Flexible IAP, Enables EEPROM Emulation
General Purpose Programmable Logic	Eliminate External Logic Devices
Broad Peripheral Set	Accommodates Wide Variety of Applications
Large Firmware Library and Excellent Tools	Get Designs to Market Very Quickly, Even if New to 8051
Low Cost Relative to other Flash 8051/8bit MCU	Cost Reduce Your Product in Very Short Time
Rich µPSD Roadmap	Extend the life of your 8051 Investment for Years to Come

µPSD

Thank You. Visit Us Soon …

www.st.com/micropsd